

What is claimed is:

1. An optical switch provided with N number of input ports and N number of output ports (herein “ N ” is a plural number), comprising:

N number of first switching parts each having one input port of the N number of input ports, N number of first coupling ports, and a plurality of optical path switching elements;

N number of second switching parts each having one output port of the N number of output ports, N number of second coupling ports, and a plurality of optical path switching elements; and

10 $N \times N$ number of optical fibers connecting the first coupling ports and the second coupling ports,

wherein the differences between the maximum and the minimum in terms of the number of the optical path switching elements through which light passes in $N \times N$ number optical paths from the input port to the output port are equal to or less than 4.

2. An optical switch as defined in claim 1, wherein

half the number or more of coupling ports $Q1i$ of $N \times N$ first coupling ports are connected with second coupling ports $Q2(N+1-i)$, where $Q1i$ is a first coupling port corresponding to an optical path which comes in the “ i ”th fewer one in terms of the number of the optical path switching elements through which the respective optical paths pass between the input port and one of the first coupling ports in each first switching part, and $Q2j$ is a second coupling port corresponding to the “ j ”th fewer one in

terms of the number of the optical path switching elements through which the respective optical paths pass between the output port and one of the second coupling ports in each second switching part.

3. An optical switch as defined in claim 2, wherein the number of the optical path switching elements through which a light signal passes in each of $N \times N$ number of optical paths from the input port to the output port is all equivalent.
4. An optical switch provided with N number of input ports and N number of output ports (herein “ N ” is a plural number), comprising:

10 N number of first switching parts each having one input port of the N number of input ports and N number of first coupling ports;

N number of second switching parts each having one output port of the N number of output ports, N number of second coupling ports; and

15 $N \times N$ number of optical fibers connecting the first coupling ports and the second coupling ports, wherein

 half the number or more of first coupling ports $P1i$ of the $N \times N$ first coupling ports are connected with second coupling ports $P2(N+1-i)$, where $P1i$ is a first coupling port corresponding to an optical path which comes in the “ i ”th shorter one in terms of the optical path length between the input port and one of the first coupling ports in each first switching part, and $P2j$ is a second coupling port corresponding to the “ j ”th shorter one in terms of the optical path length between the output port and one of the second coupling ports in each second switching part.

5. An optical switch as defined in claim 4, wherein the optical path length from the input port to the output port in the respective $N \times N$ number of optical paths is substantially the same.

6. An optical switch provided with N number of input ports and N number of output ports (herein "N" is a plural number), wherein the optical losses of a light signal traveling through $(N \times N)$ optical paths formed between the respective input ports and output ports are substantially equal.

7. An optical switch as defined in claim 6, wherein the optical switch comprises:

10 N number of first switching parts each having one input port of the N number of input ports and N number of first coupling ports;

N number of second switching parts each having one output port of the N number of output ports, N number of second coupling ports; and

15 $(N \times N)$ number of optical fibers connecting the respective first coupling ports in the first switching parts and the different second coupling ports in the second switching parts.

8. An optical switch as defined in any one of claims 1 to 7 (1, 4, and 7), wherein each of the first switching parts comprises:

20 a first planar waveguide device having N number of first coupling optical waveguides and an input optical waveguide, each of the first coupling optical waveguides including a first coupling port, and the input optical waveguide including the input port and being formed so as to cross the first coupling optical waveguides;

N number of first reflection mirrors for reflecting an incident light signal

from the input optical waveguide to the respective first coupling optical waveguides, the first reflection mirrors being inserted respectively in trenches formed at the cross-points of the first coupling optical waveguides and the input optical waveguide; and first actuators driving the respective first reflection mirrors; and

each of the second switching parts comprises:

a second planar waveguide device having N number of second coupling optical waveguides and an output optical waveguide, each of the second coupling optical waveguides including a second coupling port, and the output optical waveguide including the output port and being formed so as to cross the second coupling optical waveguides;

N number of second reflection mirrors for reflecting an incident light signal from the second coupling optical waveguides toward the output optical waveguide, the second reflection mirrors being inserted respectively in trenches formed at the cross-points of the second coupling optical waveguides and the output optical waveguide; and

second actuators driving the respective second reflection mirrors.

9. An optical switch as defined in claims 8, wherein

the first and second reflection mirrors are fixed to cantilevers provided over the first and second planar waveguide devices, respectively; and

the first and second actuators have electrodes provided over the first and second planar waveguide devices, and means for generating electrostatic attraction between the electrodes and the cantilevers.

10. An optical switch as defined in claims 9, wherein the electrodes and the cantilevers are equipped with comb teeth parts disposed facing each other.